REMARKS

Claims 1-6, 12, 13 and 18-22 are pending in this application. By this Amendment, claims 1, 2, 4 and 5 are amended, claims 7-11 and 14-17 are canceled and new claims 19-22 are added. Claims 1, 2, 4 and 5 are amended to address the teachings of the references cited in the Office Action. No new matter is added by this Amendment.

Support for the amendments to claims 1, 2, 4 and 5 can be found throughout the specification at, for example, page 7, lines 21-26, page 12, lines 6-9, page 17, lines 17-24, page 18, lines 15-22 and page 19, lines 18-26. Support for temperature range of claims 19-22 can be found throughout the specification at, for example, page 17, lines 23 and 24.

Reconsideration of the application is respectfully requested.

I. Rejections under 35 U.S.C. §102(b)

Claims 7-11 and 14-17 were rejected under 35 U.S.C. §102(b) as allegedly being anticipated by EP 1184488 to Shibata et al.

Additionally, claims 7-11 and 14-17 were rejected under 35 U.S.C. §102(b) as allegedly being anticipated by U.S. Patent No. 6,177,292 to Hong et al.

In view of the cancellation of claims 7-11 and 14-17, these rejections are moot.

Accordingly, withdrawal of these rejections is respectfully requested.

II. Rejections Under 35 U.S.C. §103(a)

A. Nikolaev et al.

Claims 1, 3 and 18 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,218,269 to Nikolaev et al. This rejection is respectfully traversed.

Nikolaev et al. fails to teach or suggest a method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group III element by

vapor phase epitaxy in a reaction chamber made at least of quartz material as recited in amended claim 1. Moreover, Nikolaev et al. fails to teach or suggest a first step of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce a halogenated product of Al, wherein the first step occurs in a first reaction zone of the reaction chamber as recited in claim 1.

FIGS. 1 and 2 of the present application illustrate the criticality of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce a halogentated product of Al. Specifically, FIG. 1 illustrates that generation of AlCl, which reacts with the reaction tube made of at least quartz, is suppressed and the generation of $AlCl_3$, which does not react with the quartz of the reaction tube, becomes predominant at 700°C or below (see FIG. 1 and page 12, lines 6-9 of the present specification). FIG. 2 illustrates that gaseous halogentated products of Al and Ga obtained at 700°C or below do not react with the quartz of the reaction tube (see FIG. 2 and page 12, lines 23-25 of the present application).

FIGS. 4 and 5 of the present application illustrate a comparative example and an example, respectively, in which HCl and hydrogen were introduced into the Al material area (first reaction zone of the reaction chamber).

In the comparative example disclosed in FIG. 4, the temperature of the Al material area (first reaction zone of the reaction chamber) was set to 850°C and AlCl gas was transported from the material area into the crystallization area (second reaction zone of the reaction chamber). As a result, the inside of the quartz reaction tube turned yellow from the oxide of Al at the middle section of the reaction tube (see page 20, lines 11-24 of the present application).

In the example disclosed in FIG. 5, the temperature of the Al material area was set to 650°C and substantially no AlCl gas was generated. Because the Al component was

transported in the form of $AlCl_3$, the reaction tube exhibited no color change (see page 20, line 26 to page 21, line 15 of the present application).

Thus, the information disclosed in FIGS. 1, 2, 4 and 5 of the present specification demonstrates that generation of AlCl, which reacts with the quartz of the reaction tube, is suppressed and the generation of $AlCl_3$, which does not react with the quartz of the reaction tube, becomes predominant at 700°C or below.

The Declaration under 37 CFR §1.132 (Declaration), filed August 16, 2007, further illustrated the criticality of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below in a first reaction zone of the reaction chamber, made of quartz, during the first step of the reaction as required in claim 1. By reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below in the first reaction zone, the Al component is transported into the second reaction zone in the form of $AlCl_3$ and prevents the quartz of the reaction tube of the second reaction zone from being corroded, damaged or discolored by the Al component therein. Graphs 1 and 2 of the Declaration illustrate SIMS depth profiles of an AlN layer for the comparative example and the example disclosed in FIGS. 4 and 5, respectively, of the present application. As discussed above, the temperature of the Al material area (first reaction zone of the reaction chamber) of the comparative example disclosed in FIG. 4 was set to 850°C and the temperature of the Al material area (first reaction zone of the reaction chamber) of the example disclosed in FIG. 5 was set to 650°C.

As shown in Graphs 1 and 2 of the Declaration, the intensity of [Si] for the comparative example disclosed in FIG. 4 as shown in Graph 1 is over 100 times as high as that of the intensity of [Si] for the example disclosed in FIG. 5 of the present application (temperature of Al material area set to 650°C). The high intensity of [Si] for the example disclosed in FIG. 5 is caused by deoxidizing and corroding of the quartz of the reaction tube

by the Al component, AlCl gas, present at the second reaction zone. As a result of reacting the solid Al with a halogenated hydrogen at a temperature of 850°C (comparative example of FIG. 4 of the present application) in a first reaction zone, the quartz of the reaction tube at the second reaction zone is deoxidized and corroded by the Al component, AlCl gas, and [Si] is emitted.

Graphs 3 and 4 of the Declaration illustrate an absorption spectra of AlN layer at the second reaction zone when the Al material area (first reaction zone) is set to 600°C and 850°C, respectively. The absorption spectra in Graph 3 has a sharper rising shape than that of the absorption spectra in Graph 4. In the data of Graph 4 (first reaction zone at 850°C), there are absorption spectra at the range of photon energy under the edge of the band (=5.818eV), while the absorption spectra in Graph 3 (first reaction zone at 600°C) is at a range of photon energy under the edge of the band (=6.109eV). Thus, the crystallinity of AlN of Graph 3 (at 600°C) is higher than that of Graph 4 (at 850°C). The crystallinity of AlN at 600°C is higher than the crystallinity of AlN at 850° C because the quartz of the reaction tube is not corroded at the temperature range of 700°C or below, such as 600°C.

Thus, the results illustrated in Graphs 1-4 of the Declaration demonstrate that reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below in a first reaction zone of the reaction chamber is critical to producing an Al component, $AlCl_3$, for transporting into the second reaction zone that prevents the quartz of the reaction tube of the second reaction zone from being corroded, damaged or discolored by the Al component therein.

Because these unexpected results are not taught or suggested by Nikolaev et al., Nikolaev et al. would not have rendered the features of claims 1 and 3 obvious to one of ordinary skill in the art.

For at least these reasons, claims 1, 3 and 18 are patentable over the applied reference. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

B. Nikolaev et al. in view of Shibata et al. and Vaudo et al.

Claims 4 and 6 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. in view of Shibata et al. and U.S. Patent No. 6,533,874 to Vaudo et al. The rejection is respectfully traversed.

As discussed above with respect to claim 1, Nikolaev et al. fails to teach the recited first step of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce an halogenated product of Al, wherein the first step occurs in a first reaction zone of the reaction chamber which is made of at least quartz.

Vaudo et al. at best teaches that a composition of the (Ga, Al, In)N is controlled by the flow of HCl over each metal as well as by the substrate temperature and by the temperature of each metal.

Neither Shibata et al. nor Vaudo et al. remedy the deficiencies of Nikolaev et al. Like Nikolaev et al. and Shibata et al., Vaudo et al. also fails to teach or suggest a method for producing an Al-containing III-V group compound semiconductor in a reaction chamber made at least of quartz material by repeating a vapor phase epitaxial growth process to deposit layers of III-V group compound semiconductors of different compositions containing Al as a group III element, wherein the method includes a first step of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce an halogenated product of Al, wherein the first step occurs in a first reaction zone of the reaction chamber as defined in claim 4. Thus, none of Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest the method of claim 4.

Because these features of independent claim 4 are not taught or suggested by Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, these applied references would not have rendered the features of claims 4 and 6 obvious to one of ordinary skill in the art.

For at least these reasons, claims 4 and 6 are patentable over all the applied references. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

C. Nikolaev et al. in view of Solomon et al.

Claims 2 and 12 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. in view of WO 00/68470 A1 to Solomon et al. The rejection is respectfully traversed.

As discussed above with respect to claims 1 and 4, Nikolaev et al. fails to teach the recited first step of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce an halogenated product of Al, wherein the first step occurs in a first reaction zone of the reaction chamber which is made of at least quartz.

Solomon et al. merely teaches that first and second reagent gas components react in a reactor to form a p-type nitride layer which is deposited on a substrate (see page 13, lines 18-21 of Solomon et al.). Further, Solomon et al. teaches that after growth of the layer as a relatively thick film, the layer may be removed from the substrate to provide a p-GaN substrate.

Solomon et al. does not remedy the deficiencies of Nikolaev et al. because Solomon et al. also fails to teach or suggest a method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group III element by vapor phase epitaxy in a reaction chamber made at least of quartz material that includes a first step of reacting a solid mixture of group III metals including Al with a halogenated hydrogen at a temperature

of 700°C or below to produce a halogenated product of group III, wherein the first step occurs in a first reaction zone of the reaction chamber as required in claim 2. Thus, Nikolaev et al. and Solomon et al., taken singly or in combination, teach or suggest the recited method of claim 2.

Because this feature of independent claim 2 is not taught or suggested by Nikolaev et al. and Solomon et al., taken singly or in combination, Nikolaev et al. and Solomon et al. would not have rendered the features of claims 2 and 12 obvious to one of ordinary skill in the art.

For at least these reasons, claims 2 and 12 are patentable over the applied references. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

D. Nikolaev et al. in view of Solomon et al., Shibata et al. and Vaudo et al.

Claims 5 and 13 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. and Solomon et al. in view of Shibata et al. and Vaudo et al. The rejection is respectfully traversed.

As discussed above with respect to claims 1, 2 and 4, Nikolaev et al. fails to teach the recited first step of reacting a solid Al with a halogenated hydrogen at a temperature of 700°C or below to produce an halogenated product of Al, wherein the first step occurs in a first reaction zone of the reaction chamber which is made of at least quartz.

None of Solomon et al., Shibata et al. and Vaudo et al. remedy the deficiencies of Nikolaev et al. Thus, Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest the recited method of claim 5.

Because this feature of independent claim 5 is not taught nor suggested by Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, the cited

references would not have rendered the features of claims 5 and 13 obvious to one of ordinary skill in the art.

For at least these reasons, claims 5 and 13 are patentable over all the applied references. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

III. New claims

The references of record, taken singly or in combination, further fail to disclose the second reaction zone is maintained at a temperature of 700°C to 1300°C, as recited in new claims 19-22.

IV. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-6, 12, 13 and 18-22 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

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